Abstract of the Invention

A Time-Of-Flight mass analyzer includes a multipole ion guide located in the ion flight path between the ion source and the flight tube of the Time-Of-Flight mass analyzer. The ion guide electronics can be set to select the mass to charge (m/z) range of ions which can be successfully transmitted to or trapped in the ion guide. All or a portion of the ions with stable ion guide trajectories in transmission or trapping mode can then undergo Collisional Induced Dissociation (CID). During ion fragmentation the multipole ion guide AC and DC electric potentials are set to transmit or trap all or a portion of the fragment ions produced by the CID process. All or a portion of the parent and fragment ion population are delivered from the multipole ion guide to the pulsing region of Time-OF-Flight mass analyzer for mass analysis. After the first ion fragmentation step, the multipole ion guide AC and DC electric potentials can again be set to select a narrow m/z range to clear the ion guide in trapping mode of all but a selected set of fragment ions. A technique is also described where the normally stepwise MS/MS^n analysis function can be merged into a single step, increasing the effective duty cycle. The multipole ion guide used for ion transmission, trapping and fragmentation can reside in one vacuum pumping stage or can extend continuously into more than one vacuum pumping stage.